Keynotes

From IoT to Services – Efficiency Matters

Mike Muller, *Chief Technology Officer, ARM Holdings plc*

The Internet of Things is driving developments from near threshold lowest power and energy sensors through to highest performance servers and networking infrastructure enabling cloud services. Despite the diversity of different products they all share the same common requirement namely efficiency. But more than just products it is the transformation of business models that make IoT an exciting opportunity.

Bio:

Mike was one of the founders of ARM. Before joining the Group, he was responsible for hardware strategy and the development of portable products at Acorn Computers. He was previously at Orbis Computers. At ARM he was VP, Marketing from 1992 to 1996 and EVP, Business Development until October 2000 when he was appointed Chief Technology Officer. In October 2001, he was appointed to the Board. He is also a non-executive director of Intelligent Energy an intellectual property company specializing in the development of modular, low carbon fuel cell systems for their partners.

The End of Moore's Law – Again

Trevor Mudge, *Bredt Professor of Computer Engineering, the University of Michigan, Ann Arbor*

Claims that Moore's Law is about to end occur with surprising regularity. Each time the claims have been proved wrong. Is it different this time? There are some indicators that it may be: Dennard scaling is breaking down and the skyrocketing cost of semiconductor fabs may stop progress before technical limits.

We will review some of the past claims that prematurely forecast Moore's Law's demise, and the developments that overcame those barriers. Those developments also resulted in significant changes to the criteria we use to design computers. We will discuss them too.

Discussion about the "end of Moore's Law" raises the question of physical limits for computer design in general. We will include them in the talk and show how they may shed light on the current claim that Moore's Law is ending.

We will review promising technologies for memories and die stacking that will allow us to move forward in the immediate future. Finally, we will discuss newer technologies that

Bio:

Trevor Mudge received the Ph.D. degrees in Computer Science from the University of Illinois, Urbana in 1977. Since then he has been on the faculty of the University of Michigan, Ann Arbor. In 2003 he was named the first Bredt Family Professor of Electrical Engineering and Computer Science. Previously he served a ten-year term as the Director of the Advanced Computer Architecture Laboratory, which is a group of eight faculty and about 60 graduate students. He is author of numerous papers on computer architecture, programming languages, VLSI design, and computer vision. He has also chaired 49 theses in these areas. His research interests include computer architecture, computer-aided design, and compilers.

In 2014 he was the recipient of ACM/IEEE CS Eckert-Mauchly Award "For pioneering contributions to low-power computer architecture and its interaction with technology." In addition to his position as a faculty member, he runs Idiot Savants, a chip design consultancy. Trevor Mudge is a Life Fellow of the IEEE, a member of the ACM, the IET, and the British Computer Society.

Investigating the Brain's Computational Paradigm

James E. Smith, *Professor Emeritus, the University of Wisconsin-Madison*

Understanding and implementing the brain's computational paradigm is the grand challenge facing computer researchers. Not only does it provide computational capabilities far beyond those of conventional computers, its energy efficiency is truly remarkable. The brain's neocortex is constructed of massively interconnected neurons that compute and communicate via voltage spikes, and a strong argument can be made that precise spike timing is an essential element of the paradigm. This argument leads to the seeming paradox that the way we naturally reason about computation is an obstacle to understanding the way our brain, itself, computes. I will describe a small set of biologically plausible computational elements based on precise spike timing. Then, through examples using these computational elements, I will illustrate some features of spike-based temporal computation and how it differs from other brain-inspired approaches. This is only one person's first step toward understanding the brain's computational paradigm, and as such it is one of many divergent theories. However, it illustrates important aspects of this grand challenge research area and serves as a case study in the way a computer researcher can participate in addressing the challenge.

Bio:

James E. Smith is Professor Emeritus in the Department of Electrical and Computer Engineering at the University of Wisconsin-Madison. He received his PhD from the University of Illinois in 1976. He then joined the faculty of the University of Wisconsin-Madison, teaching and conducting research – first in fault-tolerant computing, then in computer architecture. He has been involved in a number of computer research and development projects both as a faculty member at Wisconsin and in industry (Control Data Corporation, Astronautics Corporation, Cray Research, Google, and Intel).

Prof. Smith has made a number of significant contributions to the development of superscalar processors. These contributions include basic mechanisms for dynamic branch prediction and implementing precise traps. He has also studied vector processor architectures and worked on the development of innovative microarchitecture paradigms. He received the 1999 ACM/IEEE Eckert-Mauchly Award for these contributions.

More recently, Prof. Smith focused on the virtual machine abstraction as a technique for providing high performance and power efficiency through co-design and tight coupling of virtual machine hardware and software. He is co-author of a book on virtual machines. Currently, he is studying computational neuroscience at home along the Clark Fork near Missoula, Montana.